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Gravitational Collisions of Spherical Drops at Finite Stokes Numbers and Low Reynolds Numbers MICHAEL ROTHER, University of Minnesota Duluth, ROBERT H. DAVIS, University of Colorado at Boulder — Collision efficiencies are calculated by a trajectory analysis for two sedimenting spherical drops with exact methods for determining the hydrodynamic forces at finite Stokes number and low Reynolds number. When the Reynolds number is small, fluid inertia is negligible, and the hydrodynamic forces are linear functions of the translational velocities of the drops. However, at nonzero Stokes numbers, drop inertia must be taken into account, and the hydrodynamic forces do not balance the applied forces. For drops in close approach, lubrication forces and attractive molecular forces are considered. Comparison is made between the effects of unretarded and retarded van der Waals forces and Maxwell slip on collision efficiencies. An important application is to raindrop growth for drop radii between 10 and 30 μm. The collision efficiency goes through a minimum and then approaches the Smoluchowski limit of no hydrodynamic interactions as the drop size and Stokes number become increasingly large. Theoretical predictions are required in this range of drop sizes because experiments are difficult.

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